

# Pneumothorax Ex Vacuo Following Chemotherapy for Malignant Pleural Effusion

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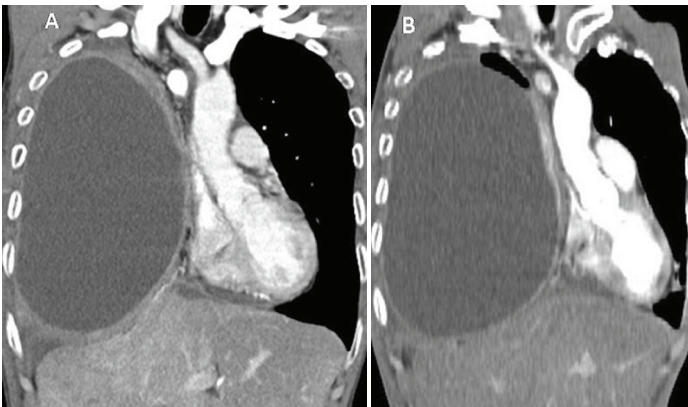
**Keywords:** Bronchoscopy, Malignant mesothelioma, Trapped lung

A 64-year-old male presented with abdominal pain and progressive swelling of abdomen for one month. Five months prior to this visit he had completed four cycles of pemetrexed-carboplatin chemotherapy for cytology proven malignant pleural effusion of unknown primary. Computed Tomography (CT) scan of chest performed prior to chemotherapy showed a large right pleural effusion with circumferential pleural thickening and contralateral mediastinal shift [Table/Fig-1]. Though he reported symptomatic improvement at completion of chemotherapy, there was hardly any change noticed in the quantity of fluid in a repeat CT scan [Table/Fig-2]. Presently he reported with abdominal symptoms and had no chest discomfort. Abdomen was tense and diffusely tender. Surprisingly, a repeat CT scan of chest and abdomen during the current visit showed reduced haemithoracic size and residual

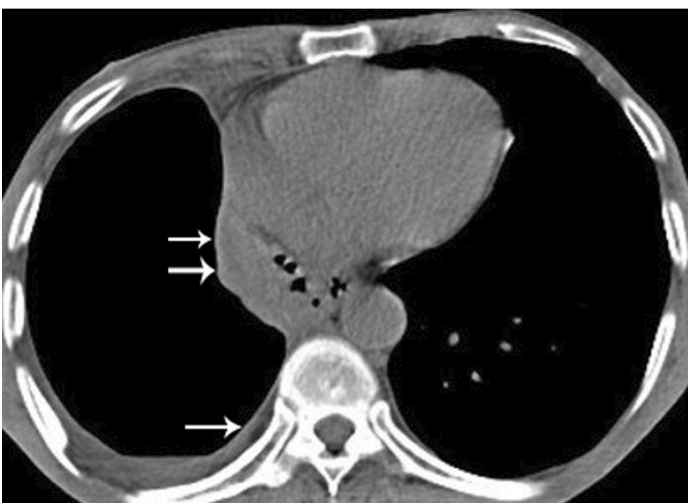
pleural rind [Table/Fig-3] preventing right lung expansion but no pleural effusion; rather the fluid was replaced by air [Table/Fig-4] suggesting a pneumothorax. He had not undergone any pleural intervention in-between excluding an iatrogenic pneumothorax. Flexible bronchoscopy performed during pre-chemotherapy evaluation and current admission excluded any endobronchial obstruction. Large ascites with peritoneal thickening was detected in abdominal scan [Table/Fig-5]. Considering the terminal illness and asymptomatic pneumothorax, no intervention was deemed necessary in our patient and ascites was managed palliatively.

## DISCUSSION

Pneumothorax ex vacuo denotes a condition where gas is drawn in to the pleural space from the ambient tissue and blood vessels owing to intrapleural 'vacuum' effect. This usually develops as a result of non-expanding lung either due to an endobronchial obstruction or extrinsic compression. The term pneumothorax ex vacuo was originally used in children to describe a pneumothorax that occurred in association with acute lobar collapse secondary to endobronchial obstruction by mucus plugging, aspirated foreign body or malpositioned endotracheal tubes and completely disappeared after removal of endobronchial obstruction. However, the term has also been used to explain the pneumothorax that develops following rapid evacuation of pleural fluid where the lung fails to expand to fill the vacant space. The pathophysiology of pneumothorax ex vacuo is very much different from the usual mechanism that produces primary or secondary pneumothorax. Generally, air gets access into the pleural space either from outside or inside the chest due to iatrogenic or non-iatrogenic trauma or



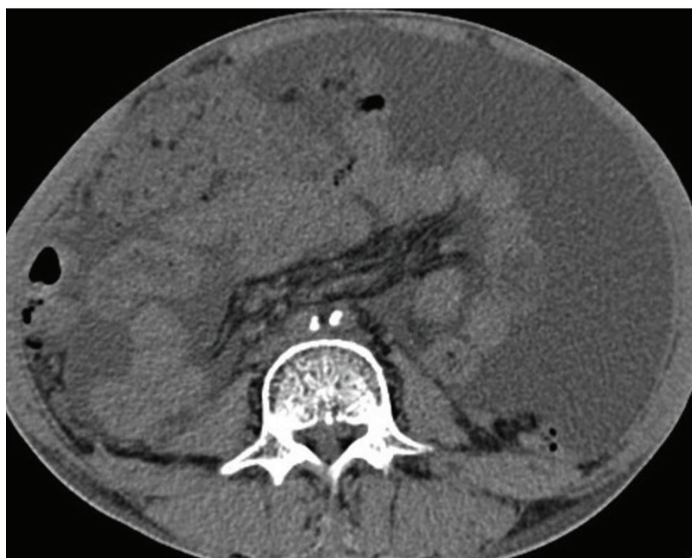
**[Table/Fig-1]:** CT scan of chest before chemotherapy showed a large right pleural effusion with circumferential pleural thickening and contralateral mediastinal shift.  
**[Table/Fig-2]:** CT scan at the end of chemotherapy showed unchanging size of the pleural effusion.



**[Table/Fig-3]:** CT scan of chest repeated five months after completion of chemotherapy demonstrated reduced size of haemithorax, formation of a visceral pleural rind (arrows) and no pleural fluid on right side.



**[Table/Fig-4]:** Lung window image in coronal section clearly showed the presence of pneumothorax and collapsed lung.



[Table/Fig-5]: CT abdomen showed large ascites with thickened peritoneum

spontaneously from rupture of subpleural blebs, bullae or diseased alveolar focus. In ex vacuo pneumothorax the situation is different where pneumothorax occurs usually in absence of any breach in visceral pleural continuity, rather a thick fibrous peel is formed over the visceral pleura by deposition of neoplastic cells in malignant pleural effusions leading to “trapped lung” phenomenon. This results in decreased lung compliance and failure of lung expansion after evacuation of pleural fluid. Chronic lung collapse can also occur in fixed endobronchial obstruction by a mass or foreign body or by extrinsic compression of bronchus. Furthermore, chronic atelectasis and interference in blood circulation may lead to decreased pulmonary surfactant and failure of lung expansion. The chronic atelectasis of lung superaded with removal of pleural fluid, leads to increased pleural negative pressure producing a vacuum-like effect that draws air from the ambient tissue and vessels producing pneumothorax. Most patients are asymptomatic

and over a period of time the fluid reaccumulates producing initially hydropneumothorax and later complete filling of pleural space by fluid [1,2]. Notably two features are interesting in this case such as: (a) unexpectedly complete resolution of pleural effusion several months after discontinuation of chemotherapy at a time when there is active accumulation of fluid in the peritoneal cavity; and (b) gradual onset of pneumothorax without any preceding pleural procedure. Diffuse pleural thickening at initial presentation, peritoneal involvement afterward and resolution of pleural fluid following pemetrexed-based chemotherapy favor the possibility of primary malignant mesothelioma in our case. Currently pemetrexed and cisplatin combination chemotherapy is an established modality of treatment in malignant mesothelioma [3]. Management should focus on identifying and removing any endobronchial mucus plugging or obstruction that allows expansion of lung. Treatment of pneumothorax ex vacuo in the context of malignant pleural effusion remains debatable as most patients are asymptomatic; scope for lung expansion is very negligible due to “trapped lung” effect and terminal illness with a median survival of few months. Placement of chest tube has not been beneficial in such patients [1] and the outcome with chest tube may be as good as simple observation [2]. Usually the pneumothorax resolves spontaneously over time or may convert into pleural effusion due to reaccumulation of fluid. Physicians should remain aware of such condition while treating malignant pleural effusion in order to avoid undue pleural intervention.

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